

Guest Column: A New Residential Model

How To: The Energy Efficient Remodel

By Courtney Lowery, 7-02-08

A few months ago [I wrote an article on how the nation's energy issues](#) are affecting the typical American household and specifically how the construction of new homes should change to accommodate the rise in energy prices. Since the publication of the article, the most asked question is, "What can I do about the house I live in now?" This is often followed by some discussion about how much more sustainable it is to remodel our existing houses than it is to build new homes. We will need to build new homes, but clearly the majority of the energy burden on the typical American household will come from existing houses.

Natural gas is currently priced at \$14.91 per dekatherm (per Northwest Energy) and many including members of Montana's Public Service Commission, expect that the price will far exceed \$15 per dekatherm by this coming winter. Last year at this time natural gas was approximately \$10 per dekatherm. Average homes that use natural gas may have natural gas bills alone that are \$300 with electric bills that are \$100. Fuel prices for our vehicles are now over \$4 a gallon and food prices are rising at unprecedented rates. The average American household budget is being hit hard and low income households are being hit even harder. Minor changes to existing houses can be made that offset much of the rate increases that are forthcoming. Major changes to existing houses can be made that can significantly decrease energy costs.

The prospect of remodeling of existing houses for energy efficiency is more complicated than new houses and varies greatly with the age of the house and variations in construction type. In this article I will attempt to cover a wide variety of different construction types and hopefully provide a better understanding of what can be done to make your house more energy efficient. This article is focused on energy efficiency relative to cost and does not directly address issues of carbon offsetting and other sustainability issues that are critical to long term sustainability.

Any remodel should start with your project goals and a project budget. The following suggestions will either fit or not fit your existing house, your goals, or your budget. I recommend hiring a design professional to assist you with identifying which of these suggestions combine to make the most efficient house possible within your goals and your budget. The following is a list of ideas to get you started and hopefully makes you a more informed home owner.

1.) Start with analyzing the existing conditions. You can do some of these yourself or you can hire a professional. The following is a list of items that should be known before starting.

- Review your power and gas bill and determine the average energy used over a one year period. Your electricity will be in KW/h and your gas will be in dekatherms.

- Review your house design and determine if there are significant deficiencies. See below for a further description.
- Have a blower door test done by the local energy provider or a professional. Several new companies are specializing in energy retrofits and will perform a blower door test for around \$300.
- Review your appliances and determine their energy efficiency. Once you have determined make and model number you can go onto the Energy Star website and look at the efficiency rating.
- Review your light fixtures. Determine what kind of bulbs and wattage is used in each fixture. Also identify if you have recessed lighting in insulated ceilings.
- Review your small appliances that are plugged in all of time such as microwaves, TVs, DVD players, computers, etc. These “ghost loads” can be as much as 15% of your power bill.
- Identify your insulation values. Most houses have wood frame walls and are either 2x4 or 2x6 studs. If you have insulation in a 2x4 wall, it probably has around R-11 insulation value and a 2x6 wall around R-19. Some older houses may have never been insulated. Ceilings typically have attic spaces or are enclosed in vaulted or flat roof areas. Attic spaces are required to have access panels that will allow you to check the depth of the insulation. Vaulted ceilings can have varying depths depending on the structure. Basements and crawl spaces should also be reviewed and a determination made on the level of wall insulation.
- Identify your window types. What is the frame type (wood, vinyl, aluminum) and what is the glass type (single pane, double or triple pane)? Do you have storm windows?
- Identify your mechanical system and the efficiency. There are many types of systems. The most common system is a forced air system that will have a furnace with an efficiency rating on the label. Hot water boilers are also common and will also have an efficiency rating on the label. Electric baseboards are also common.
- Identify your hot water system and the efficiency. Your hot water heater will most likely have an efficiency rating on the label.

2.) Next, look at the options for increasing your energy efficiency.

- After you have determined what your electric and gas usage is, you can use this information as a benchmark for decreasing use.
- The blower door test will tell you where the leaks are in the envelope of your house. Some of the leaks will be easy to fix and can be done immediately and inexpensively. Weather-stripping at doors can be added to stop leaks. Windows can be sealed and you should contact the window manufacturer to determine the best methods. Leaks at electrical outlets and switches in exterior walls can be sealed with foam insulation. Leaks at duct and electrical penetrations, rim joists in the basement, etc., can also be filled with foam.
- If your existing house design has the following, you may want to consider upgrades.
 1. Significant number of windows on the north and very few windows on the south.
 2. Significant number of windows on the west side that can lead to overheating in the summer.
 3. No overhangs on the south windows and no protection on the west windows. A lack of overhangs can also lead to overheating.
 4. No ventilation or poor ventilation in the attic, which can also lead to overheating.
- Use the Energy Star website to determine the efficiency of your appliances and consider upgrading to the latest Energy Star appliances.
- Unplug your small appliances that are creating “ghost loads” when not in use.
- If your light fixtures are utilizing incandescent bulbs upgrade them to compact fluorescent bulbs (CFLs). If you have low voltage bulbs, there are some new LED alternatives. Consider adding occupancy sensors to rooms that you are in and out of on a regular basis. These can mount to an existing switch and are inexpensive at

approximately \$20 each. If you have recessed lighting in insulated ceiling spaces, consider removing and replacing with a surface mounted fixture. Recessed lighting often reduces insulation values and creates “holes” in your insulation.

- After you have identified your insulation values, determine what can be done to increase your insulation values. The following are some ideas depending on the level of remodel that you are considering:
 1. Minor energy upgrade. Insulate the walls with blown-in insulation if they are not insulated. This can often be done by drilling through the exterior siding and adding blown-in insulation. R-values will depend on wall thickness with R-11 or 13 for a 2x4 walls and R-19 or R-21 for a 2x6 walls. If you have an attic space, increase the depth of insulation by adding additional insulation on top. I recommend achieving a minimum of R-50 in the attic. Make sure to maintain the attic ventilation at eaves and consider adding rigid or foam insulation in these areas to increase your insulation value at the perimeter. If the walls of your basement or crawl space are not insulated, I recommend a minimum of R-19. This can be added to the inside of the walls.
 2. Major energy upgrade. Consider increasing the wall insulation by removing the siding and adding 1” to 2” of rigid insulation on the outside. This will require re-siding the building after the insulation is added. If you have 2x4 walls, I recommend a minimum of 2” of additional rigid insulation. If you have 2x6 walls, 1” of additional rigid insulation is recommended. Adding additional insulation to the exterior walls will require either removing the existing windows and moving them to the outside of the insulation or providing a flashing detail to accommodate for the additional wall thickness. If you have an attic, consider removing the existing loose fill insulation and adding 2” of sprayed on foam over the “lid” and reinstalling the loose fill insulation over the top. I recommend a minimum total insulation of R-50 at the attic. If you have vaulted ceilings you may consider adding an additional layer of rigid insulation on the inside surface of the ceiling and then adding a new interior finish.

- Your options for windows vary based on the type of windows you currently have and if you are considering replacement or not. The one suggestion that fits all types of windows is to add blinds to the windows that have a minimum of R-5 rating. This will reduce both heating and cooling costs. I have listed a variety of window types below with recommendations for increasing energy efficiency.
 - Aluminum frames with single pane glass: Replacement is your best option.
 - Aluminum frames with double pane glass: Again, total replacement is the best option due to the substantial heat loss at the frame.
 - Wood frames with single pane glass: Replacement of the entire window or a sash replacement is the best option.
 - Wood frames with double pane glass: Replacement is most likely not necessary. You can consider upgrading to triple pane, but the payoff may not make sense financially.
 - Vinyl frames with single pane: Total replacement is the best option.
 - Vinyl frames with double pane glass: Replacement is most likely not necessary. You can consider upgrading to triple pane, but the payoff may not make sense financially.
 - When replacing any window: Consider windows that have a U-value of .35 or less and discuss glass types with the window manufacturer to determine the best options for solar gain.
- Once again, your options for mechanical system upgrades will depend greatly on your existing system. I have listed a variety of systems with recommendations for increasing your energy efficiency.
 - If you have an existing forced air furnace with 80% efficiency or less, consider upgrading to a furnace with 95% efficiency or better. Also, have your ducts sealed and insulated.
 - If you have an existing hot water boiler with 80% or less efficiency, consider upgrading your boiler to a unit with 93% efficiency or better. These boilers are typically condensing/modulating gas boilers.
 - If you have electric baseboard heat, consider upgrading to more efficient system such as those noted in this section. Upgrading will depend greatly on available space for ductwork, equipment, and the extent of your remodel.

- With any mechanical system you may want to consider adding a pellet stove which can supplement your existing heating at lower costs.
 - With any mechanical system you may want to consider upgrading to a ground source heat pump (hot water or forced air). These systems have relatively high up front costs, long pay off times, have limitations relative to applicability, but are very efficient. Another advantage of these systems is the ability to offset the power usage with a photovoltaic solar array.
 - If you have a radiant heating system (in-floor or baseboard), you should consider a heat recovery ventilator to provide fresh air and circulation in a very efficient manner. This will be necessary to provide a safe, comfortable living environment especially if the house has achieved a low air infiltration rate.
- Your options for domestic water heat also depend on your existing system.
 - If you have any hot water heater, a minimum step is to provide an insulation blanket around the hot water heater to increase its efficiency. These may be free with an energy audit by your local power company.
 - If you have a standard hot water heater of any fuel source, you should consider changing to an on-demand system that produces heated water only when needed.
 - If you have any hot water system, consider adding a flat plate or evacuated tube solar collector to offset your domestic hot water costs.
 - If you have an electric hot water heater, do not have a solar array to offset electric costs, and have access to natural gas, you may want to consider changing to a 95% plus efficient gas hot water heater. The benefits of this will depend on future energy costs and your local power costs.
 - If you have a gas hot water heater with less than or equal to 80% efficiency, you should consider upgrading to 95% plus efficiency.

The information provided in this article is general in nature. Specifics can be obtained through design professionals, builders, your energy suppliers, and from the Energy Star

website. Consider your house as a machine that performs better if all of the parts work together. Your machine may need repair from a professional that knows how all of the parts work together.

With some minor costs for energy retrofits, you can offset the upcoming rate increases for both gas and electricity. While you are saving money, you will be reducing your carbon footprint, creating cleaner air and potentially providing power to others.